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(54) **FIXING DEVICE WITH SHEET SEPARATING DEVICE THAT USES COMPRESSED GAS AND IMAGE FORMING APPARATUS**

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See application file for complete search history.

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(57) **ABSTRACT**

A sheet separating device is attached to a fixing device. The fixing device includes: a fixing member that is a rotary body having a heating unit; and a pressing member that is pressed against and is brought into contact with the fixing member. The fixing device conveys a sheet material that carries unfixed toner thereon through a nip section formed by the fixing member and the pressing member so as to fix the unfixed toner image to the sheet material. The sheet separating device includes: at least one nozzle member that discharges compressed gas from the direction of a nip outlet toward the nip section along the fixing member. The nozzle member is rotatably supported by a shaft member that is provided parallel to the fixing member and includes a gas flow passage through which compressed gas is supplied to the nozzle member.

11 Claims, 4 Drawing Sheets

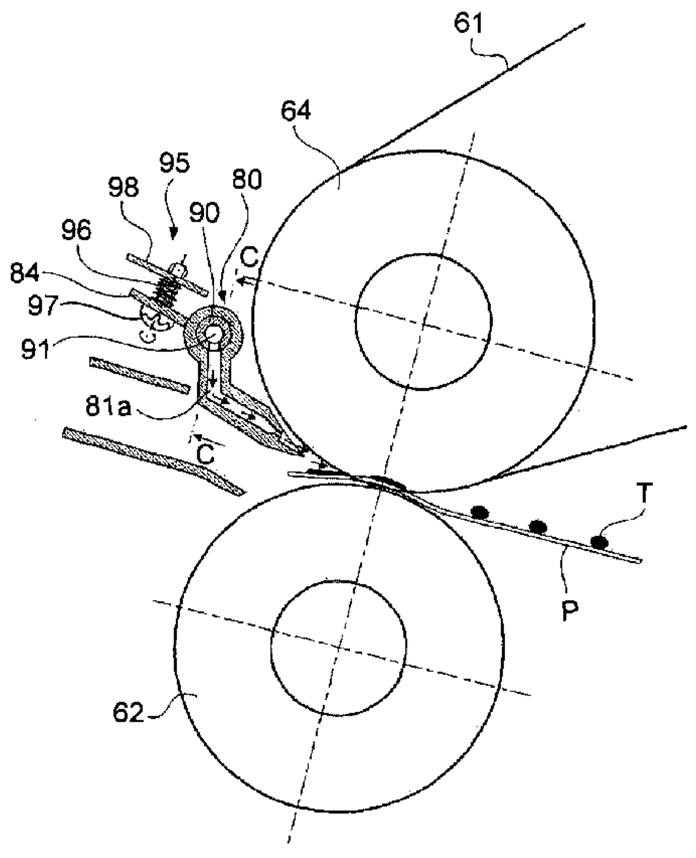

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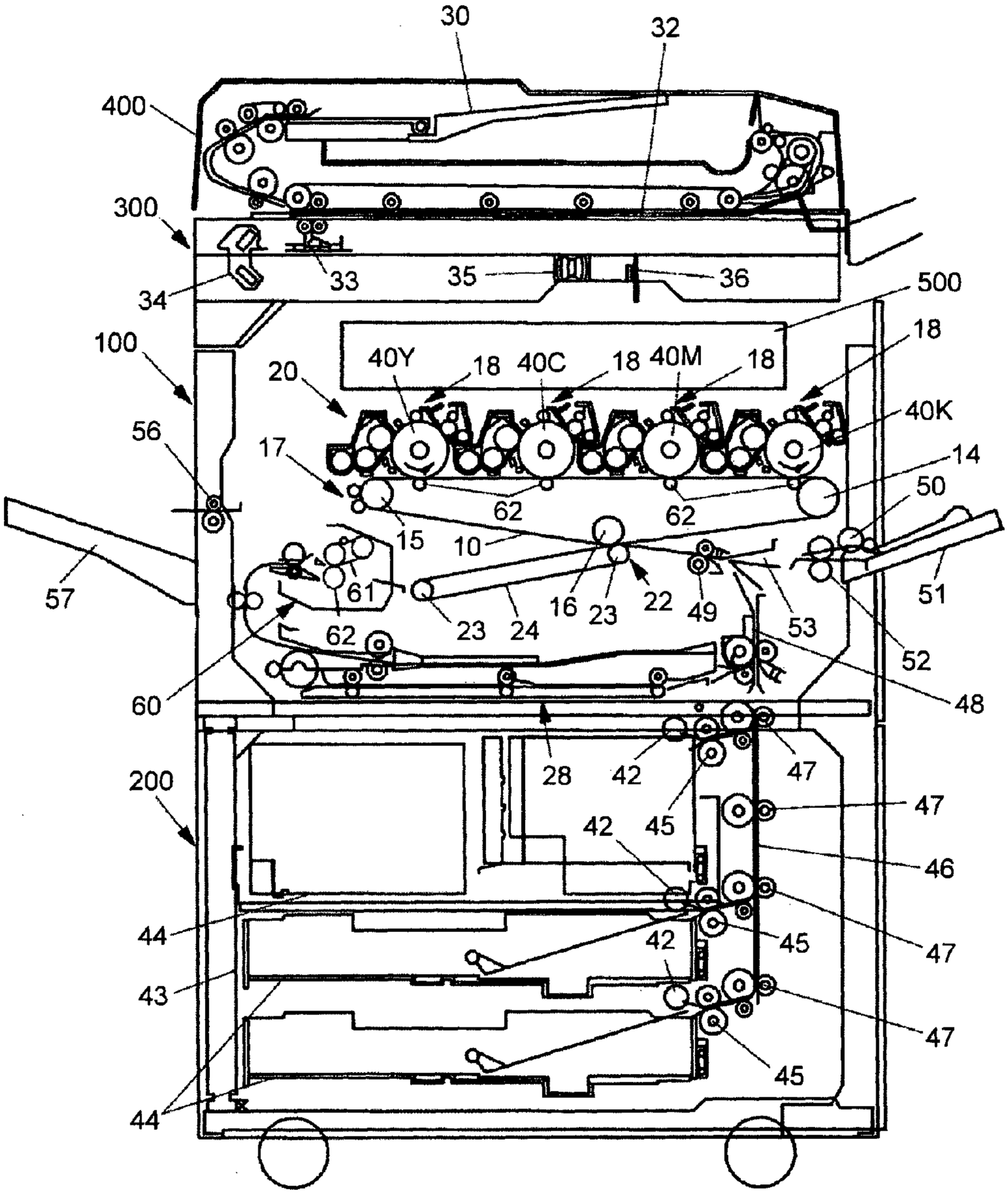
FIG.1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17
14
62
62
50
15
10
57
61
16
23
22
49
53
51
23
24
62
52
60
48
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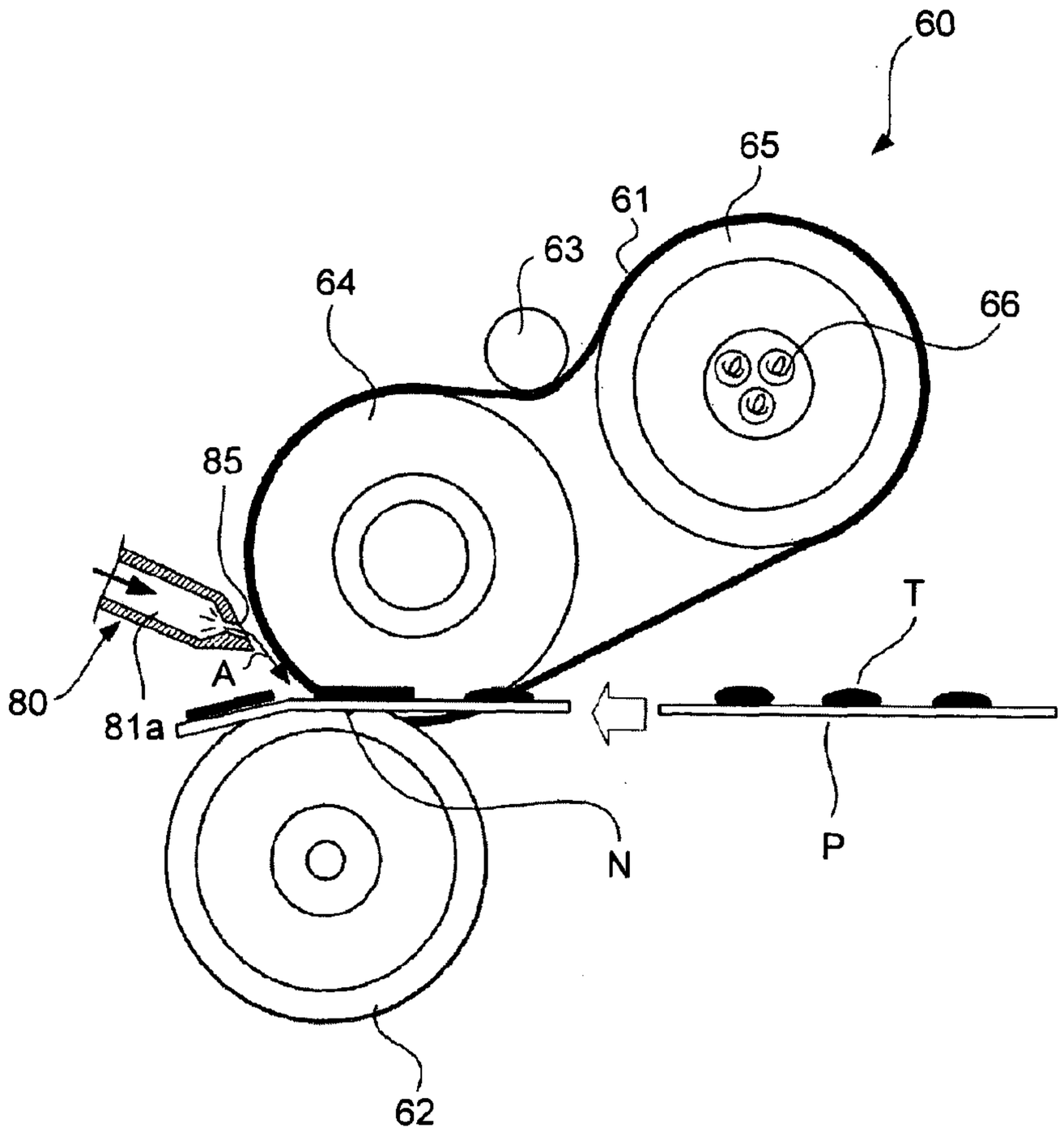
45
47
44

FIG.2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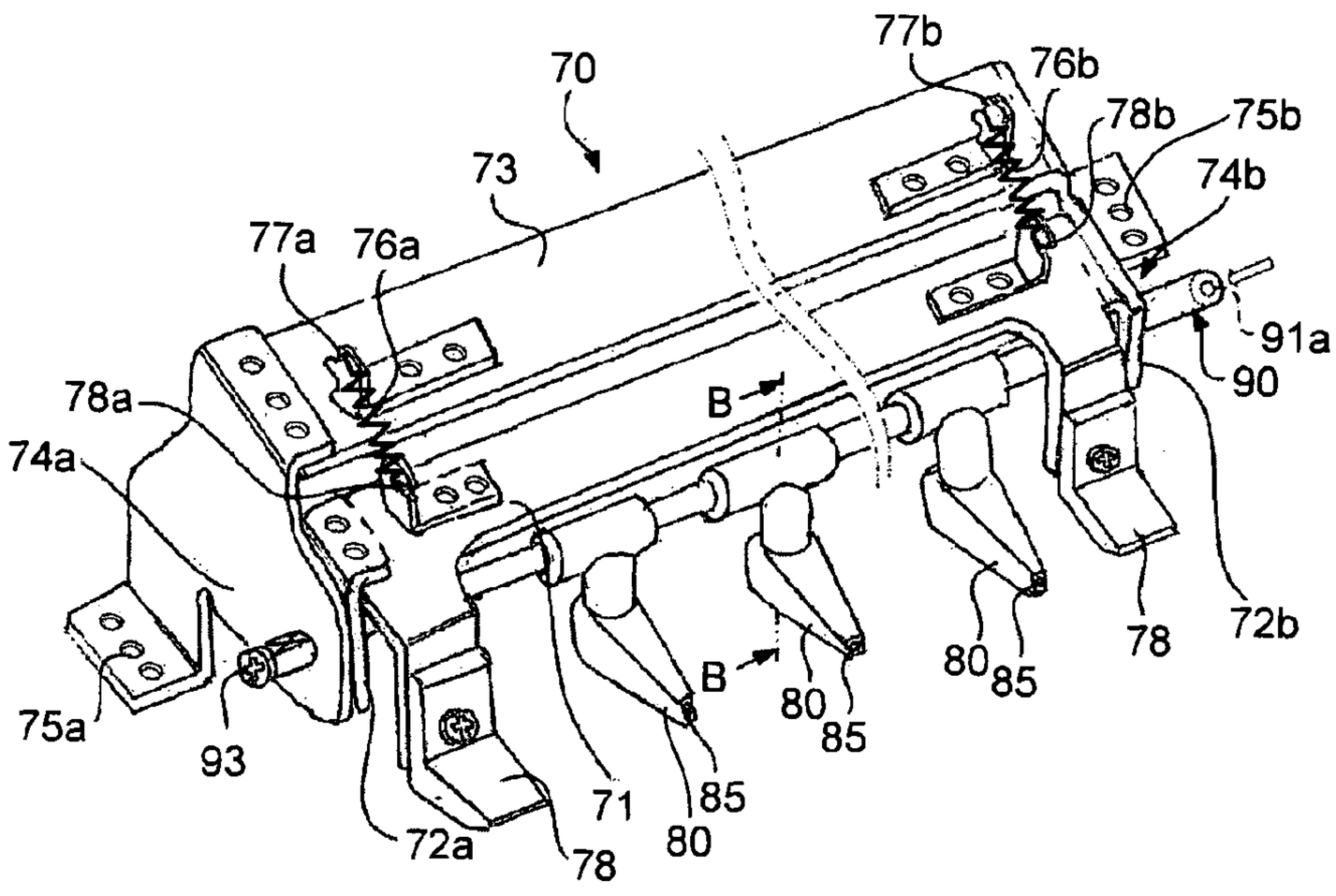
65
61
63
64
66
85
T
A
80
81a
N
P
62

FIG.3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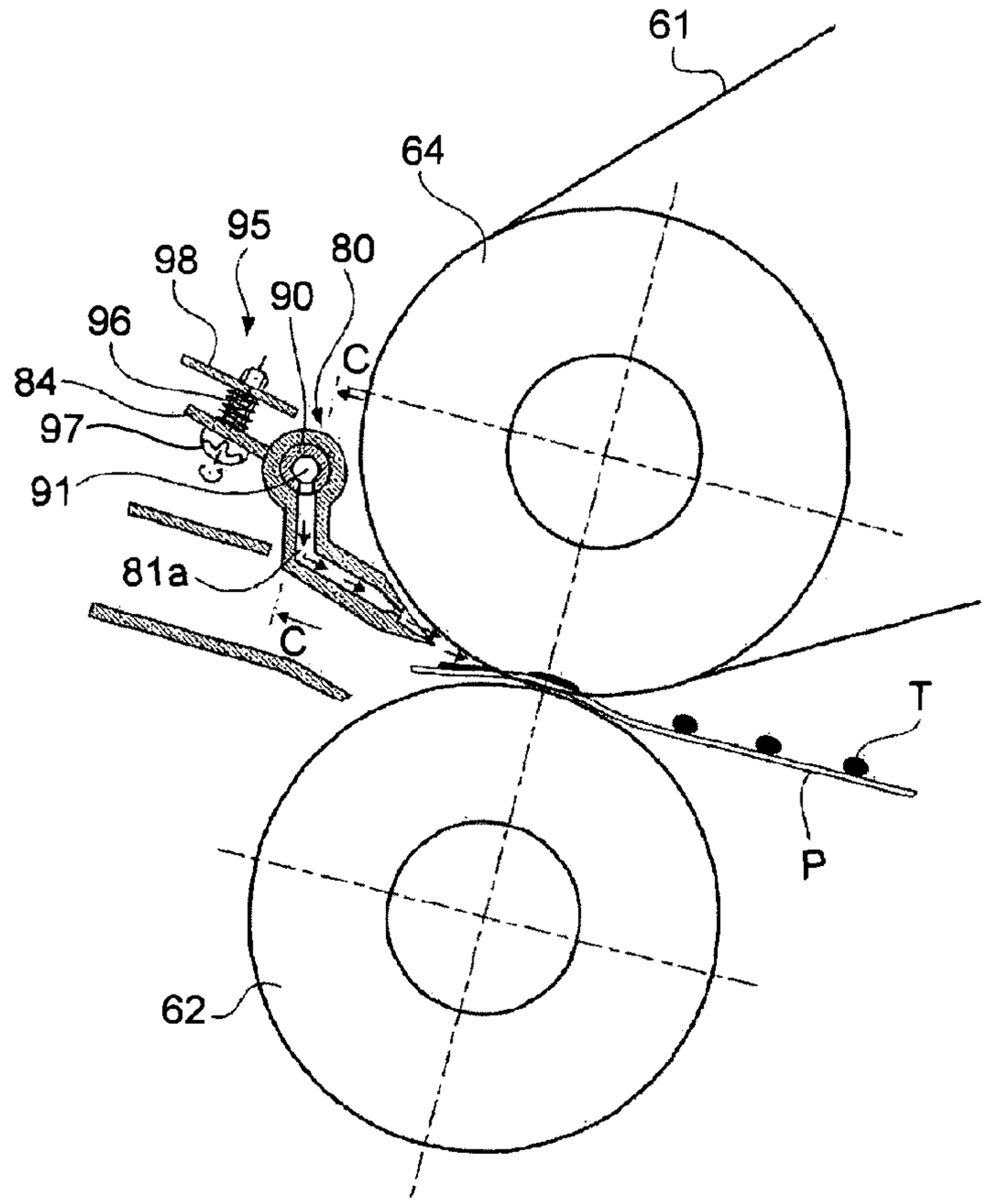
72a
78

FIG.4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90
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97
91
81a
C
T
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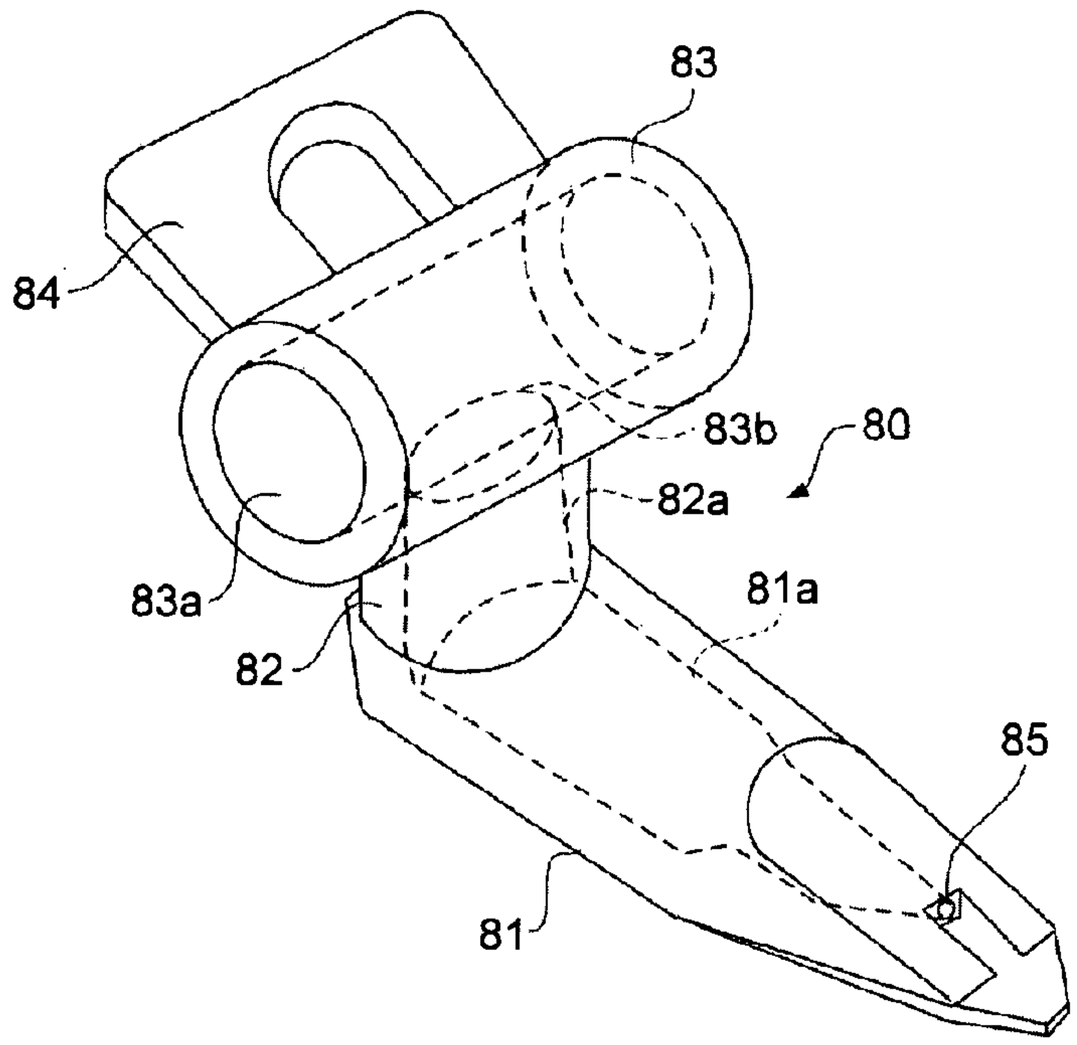
62

FIG.5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84
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80
82a
83a
81a
82
85
81

FIG.6

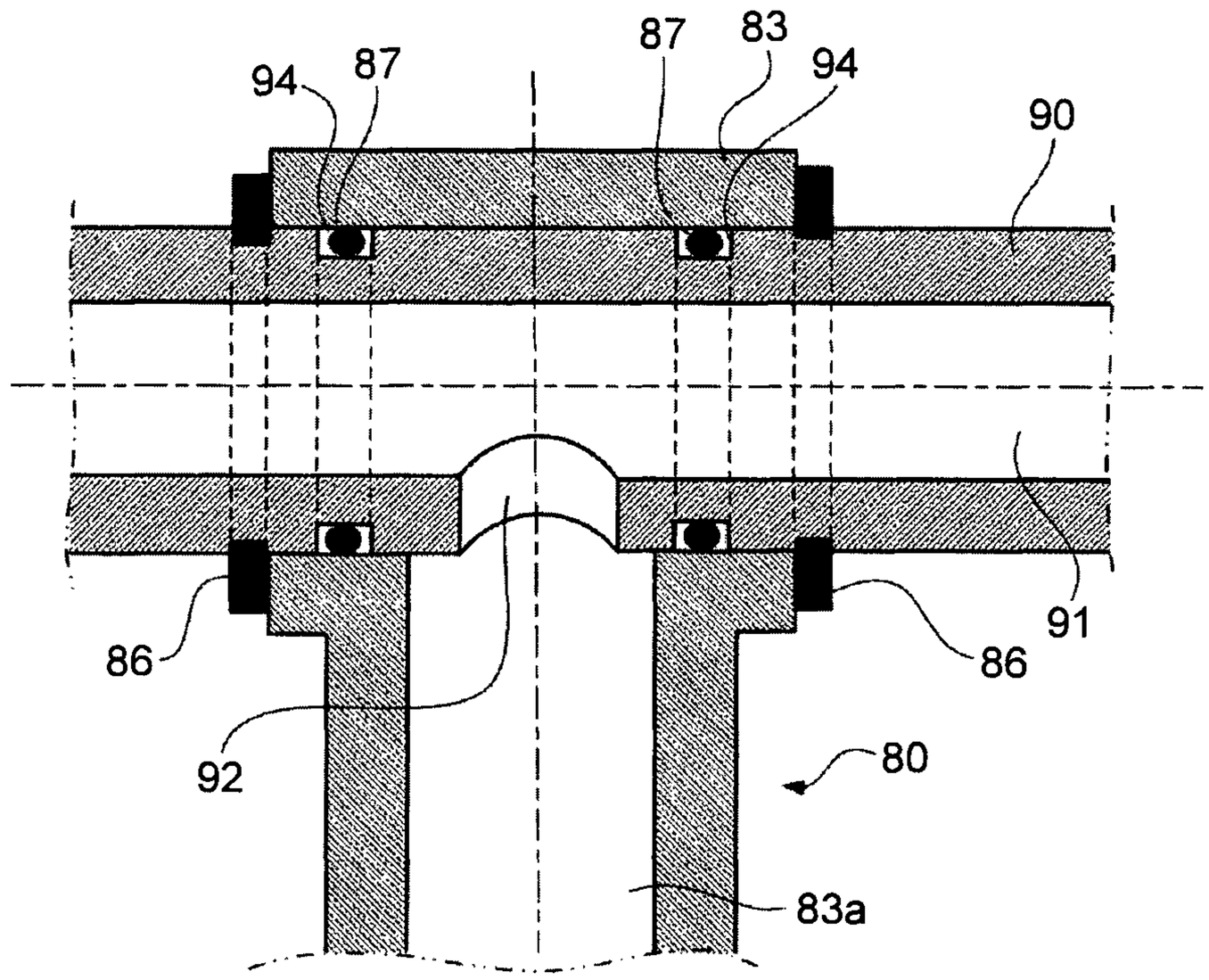
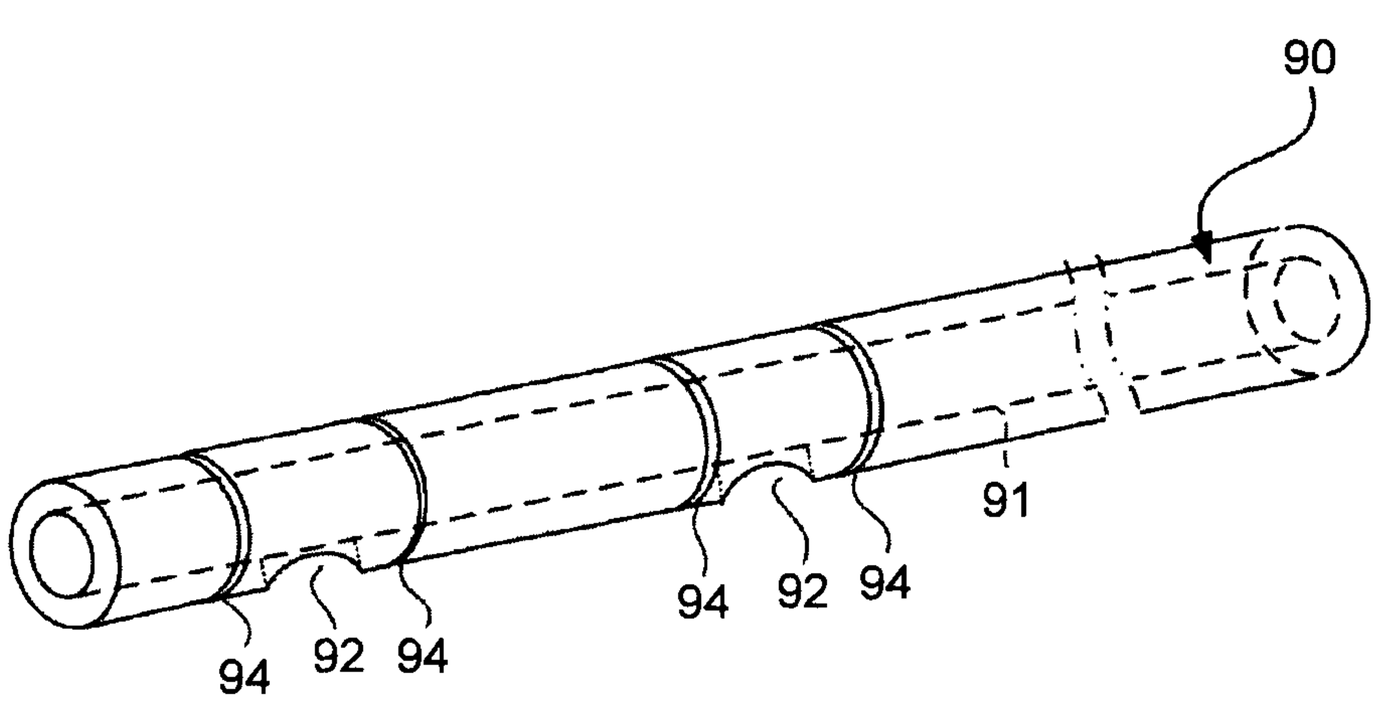


FIG.7



FIXING DEVICE WITH SHEET SEPARATING DEVICE THAT USES COMPRESSED GAS AND IMAGE FORMING APPARATUS

TECHNICAL FIELD

The present invention relates to a sheet separating device, a fixing device, and an image forming apparatus, more particularly, to a sheet separating device that discharges compressed gas so as to separate a sheet from a fixing member, to a fixing device, and to an image forming apparatus.

BACKGROUND ART

An electrophotographic image forming apparatus includes a fixing device that applies heat and pressure to a sheet material, such as a sheet of paper, onto which a toner image has been transferred, so as to fix the toner image. There is a fixing device that has a heat-roller fixing system in which a nip section is formed by a fixing roller that has an internal heat source, such as a halogen heater, and by a pressing roller that is in contact with the fixing roller; and the sheet material to which the transferred toner image has not been fixed is conveyed through the nip section so that the unfixed toner image is fixed to the sheet material.

Furthermore, a fixing device that has a belt-fixing system is also used, in which a ring-shaped fixing belt is extended between a heater roller that has an internal halogen heater, or the like, and a fixing roller that is located adjacent to the heater roller; a nip section is formed by the fixing belt and a pressing roller that is in contact with the fixing roller via the fixing belt; and the sheet material to which the transferred toner image has not been fixed is conveyed through the nip section, whereby the unfixed toner image is fixed to the sheet material.

The fixing device that has this fixing-belt system mentioned above offers advantages in that, because of the low heat capacity of the fixing belt, warming-up time can be shortened and power consumption can be suppressed.

In the fixing device, the toner image that adheres to the sheet material is brought into contact with the fixing roller and the fixing belt; therefore, the surfaces of the fixing roller and the fixing belt are coated with a fluorinated resin that provides superior separation performance, and a separation claw is used to separate the sheet material.

The major disadvantage in using the separation claw is in that, as the separation claw is brought into contact with the fixing roller and the fixing belt, the surfaces of the fixing roller and the fixing belt can easily receive a claw mark (claw scar) and, if the fixing roller, or the like, is damaged, a line occurs on the image output to the sheet material.

Usually, in the case of black-and-white image forming apparatuses, a metallic roller whose surface is coated with silicone resin is used as the fixing roller; therefore, even if the separation claw is brought into contact with the fixing roller, it is hard for the fixing roller to be damaged and the operating life can be longer. Color image forming apparatuses use silicone rubber coated with fluorine for the surface layer (generally a PFA tube of several dozen micrometers is used) or use silicone rubber with oil applied to its surface, whereby improving the colors.

However, a fixing roller that has the above configuration has a problem in that the surface layer is soft and easily becomes damaged. If the surface layer becomes damaged, a linear scar occurs on the fixed image. Therefore, nowadays, many color image forming apparatuses do not use a contact unit, such as a separation claw, and most of them perform non-contact separation.

For non-contact separation, if the adhesion between the toner and the fixing roller is strong, the fixed sheet of paper easily becomes wrapped around the roller and jammed; therefore, a wrapping jam easily occurs. Particularly with color image formation, a number of toner layers are formed and, because of the increased adhesion, a wrapping jam easily occurs.

Nowadays, color image forming apparatuses mainly use the following systems (1) to (3) for sheet separation:

(1) A non-contact separation plate system in which a small gap (about 0.2 mm to 1.0 mm) is provided between the fixing roller and the fixing belt; and separation plates are used that are arranged parallel to the fixing roller and the fixing belt in the longitudinal direction and the cross direction.

(2) A non-contact separation claw system in which a small gap (about 0.2 mm to 1.0 mm) is provided between the fixing roller and the fixing belt; and separation claws are used that are arranged at a predetermined interval.

(3) A self-stripping system in which a sheet of paper is naturally separated due to the rigidity of the paper and the elasticity of the curved portions of the fixing roller and the fixing belt.

In any of the above-described systems (1) to (3), however, a clearance is provided for a sheet guide plate guiding to the fixing outlet; therefore, when a thin sheet of paper or a sheet material that has a small margin at its end is delivered, or when a sheet material on which a solid image such as a picture is formed is delivered, the sheet material passes through the clearance while it adheres to the fixing roller or the fixing belt. Thus, a sheet wrapping jam may occur, or a jam may occur because the sheet hits the separation plate or the separation claw.

In order to ensure non-contact separation of a sheet material, a technology for spraying compressed gas, such as air, at the sheet separation position has been disclosed and is used (see, e.g., Patent Literature 1, Patent Literature 2, Patent Literature 3, Patent Literature 4, Patent Literature 5, and Patent Literature 6, which will be described below). According to the above, compressed air is sprayed at the gap between the fixed toner image on the sheet of paper and the fixing member so that the sheet is forcibly separated from the fixing member.

In recent years, it has become typical with color electrophotographic toner that when a large amount of toner is attached to the sheet material, it is required to increase the accuracy with which compressed air is sprayed in order to ensure removal of the sheet material from the fixing sheet. Therefore, it is necessary to accurately maintain the positional relation between the nozzle member that sprays compressed air and the surface of the fixing member. Specifically, the gap between the end of the nozzle member and the fixing member is kept constant regardless of the rotary movement of the fixing member and thermal expansion of the fixing member.

Patent Literature 7, which will be described below, discloses a technology for dealing with the oscillation of the surface of a fixing member that is a rotary body or a change in the diameter of the fixing member due to thermal expansion so as to accurately maintain the gap between the non-contact separation claw and the surface of the fixing member. A positioning plate is brought into contact with and is pressed against the surface of the fixing member so that the positioning plate oscillates such that the gap between the end of the non-contact separation claw and the fixing member is kept constant.

[Patent Literature 1] Japanese Patent Application Laid-open No. S51-104350

[Patent Literature 2] Japanese Patent No. 2876217

[Patent Literature 3] Japanese Patent Application Laid-open No. H11-334191
[Patent Literature 4] Japanese Patent Application Laid-open No. 2007-189015
[Patent Literature 5] Japanese Patent Application Laid-open No. 2007-240920
[Patent Literature 6] Japanese Patent Application Laid-open No. 2008-102408
[Patent Literature 7] Japanese Patent Application Laid-open No. 2009-31759

However, the technology disclosed in Patent Literature 7 can not be applied to the fixing device that includes a nozzle member without making changes to the technology.

There is a need to provide a sheet separating device that is capable of accurately maintaining the positional relation between the nozzle member and the fixing member, wherein the nozzle member sprays compressed gas at the gap between the fixed sheet material and the fixing member so as to separate the sheet, and to provide a fixing device and an image forming apparatus.

DISCLOSURE OF INVENTION

In an embodiment, a sheet separating device is attached to a fixing device. The fixing device includes: a fixing member that is a rotary body having a heating unit; and a pressing member that is pressed against and is brought into contact with the fixing member. The fixing device conveys a sheet material that carries unfixed toner thereon through a nip section formed by the fixing member and the pressing member so as to fix the unfixed toner image to the sheet material. The sheet separating device includes: at least one nozzle member that discharges compressed gas from the direction of a nip outlet toward the nip section along the fixing member. The nozzle member is rotatably supported by a shaft member that is provided parallel to the fixing member and includes a gas flow passage through which compressed gas is supplied to the nozzle member.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a schematic cross-sectional view that illustrates the configuration of an image forming apparatus according to an embodiment;

FIG. **2** is a schematic diagram that illustrates a fixing device according to the embodiment;

FIG. **3** is a perspective view of a sheet separating device according to the embodiment;

FIG. **4** is a perspective view that illustrates a compressed-air ejection nozzle member;

FIG. **5** is a cross-sectional view of the nozzle member in the sheet separating device taken along the line B-B of FIG. **3**;

FIG. **6** is a perspective view that illustrates the nozzle member in the sheet separating device; and

FIG. **7** is a perspective view that illustrates a shaft member in the sheet separating device.

BEST MODE(S) FOR CARRYING OUT THE INVENTION

In a fixing device according to an embodiment, a shaft member has a gas flow passage inside it and a nozzle member can oscillate around the shaft member as its rotation axis, so that the tube passage of compressed gas is prevented from being moved and, as a result, the gap between the nozzle member that is connected to the tube passage and the fixing member does not change. Furthermore, in order to accurately maintain the size of the gap between the nozzle member and the surface of the fixing member, a positioning plate is in direct contact with the surface of the fixing member so that the shaft member and the nozzle member oscillate. Moreover, the nozzle member is arranged such that the size of the narrowest area of clearance between the nozzle member and the fixing member is equal to or less than 2.0 mm, whereby it is possible to effectively separate the sheet material.

In order to prevent scrapes on the fixing member from affecting the fixed image, the contact point of the positioning plate that is in contact with the fixing member is located outside the area where the largest image is formed. Moreover, if the fixing member and the pressing member are configured as roller-shaped rotary bodies, an air injection member can be used only in the area for conveying sheets at the fixing outlet, and the flexibility for arrangement of the nozzle member is limited; therefore, the nozzle member has a tapered shape and it includes a compressed gas passage that is tapered toward the injection port.

Moreover, a position adjustment mechanism is provided to perform adjustment to prevent variations in the set clearance between the end of the nozzle and the fixing member even if the temperature is high, if the fixing member is used of which error in the diameter is large, or if there is a dimension tolerance of a nozzle component or assembly variation. Furthermore, it is possible to prevent leakage of compressed air through the fitting clearance between the rotation shaft, which is a tube passage of compressed gas, and the nozzle member, and therefore it is possible to spray compressed gas in an effective and stable manner.

EMBODIMENTS

An explanation is given below of a sheet separating device, a fixing device, and an image forming apparatus according to an embodiment.

FIG. **1** is a schematic cross-sectional view that illustrates the configuration of the image forming apparatus according to the embodiment. In the drawing, the reference numeral **100** denotes a copier main body, the reference numeral **200** denotes a sheet feed table, the reference numeral **300** denotes a scanner, the reference numeral **400** denotes an automatic document feeder (ADF), and the reference numeral **500** denotes an exposure device. The copier main body **100** is placed on the sheet feed table **200**, the scanner **300** is mounted on the copier main body **100**, and the ADF **400** is further mounted on it.

An endless belt-like intermediate transfer member **10** is provided in the center of the copier main body **100**, is extended by three supporting rollers **14**, **15**, **16**, and is configured to rotate and move in the clockwise direction of the drawing. In this example, an intermediate-transfer-member cleaning device **17** is provided on the left of the second supporting roller **15** out of the three supporting rollers to remove residual toner that remains on the intermediate transfer member **10** after an image is transferred.

Four image forming units **18** for yellow, cyan, magenta, and black are located above the intermediate transfer member **10** between the first supporting roller **14** and the second supporting roller **15** out of the three supporting rollers and are arranged side by side along the conveying direction of the intermediate transfer member **10**, whereby a tandem image forming device **20** is configured. The exposure device **500** is located above the tandem image forming device **20**, as illustrated in the figure.

Furthermore, a secondary transfer device **22** is provided on the opposite side of the tandem image forming device **20** with

the intermediate transfer member **10** interposed therebetween. In the illustrated example, the secondary transfer device **22** is configured such that a secondary transfer belt **24**, which is an endless belt, is extended between two rollers **23**, and the secondary transfer device **22** is arranged so that the secondary transfer belt **24** is pressed against the third supporting roller **16** via the intermediate transfer member **10**, whereby an image on the intermediate transfer member **10** is transferred onto a sheet that is a transfer material.

A fixing device **60** is provided on the side of the secondary transfer device **22** to fix a transferred image to a sheet. The fixing device **60** is configured such that a pressing roller **62** is pressed against a fixing belt **61** that is an endless belt. The above-described secondary transfer device **22** has a sheet conveying function whereby the sheet is conveyed to the fixing device **60** after the image has been transferred. It is obvious that a transfer roller or non-contact charger may be provided as the secondary transfer device **22**; however, in such a case, it is difficult to also provide the sheet conveying function.

In the illustrated example, a sheet reverse device **28** is provided under the secondary transfer device **22** and the fixing device **60** and is arranged parallel to the above-described tandem image forming device **20** to turn over the sheet so that an image is recorded on both sides of the sheet.

An explanation is given of an operation to make a copy using the above color electrophotographic device. The original document is placed on an original-document board **30** of the automatic document feeder **400**, or the automatic document feeder **400** is opened so that the original document is placed on a contact glass **32** of the scanner **300** and the automatic document feeder **400** is closed to press the original document.

The scanner **300** is driven to move a first carrier **33** and a second carrier **34** immediately after an undepicted start switch is pressed if the original document has been placed on the contact glass **32** or, conversely, after the original document is conveyed to the contact glass **32** if the original document has been placed on the automatic document feeder **400**. Light is emitted by a light source in the first carrier **33**, and the light reflected by the document surface is further reflected so that the light enters the second carrier **34**. The light is then reflected by a mirror in the second carrier **34**, and the reflected light enters a read sensor **36** via an imaging lens **35**, whereby the contents of the original document are read.

Furthermore, when the undepicted start switch is pressed, one of the supporting rollers **14**, **15**, **16** is driven and rotated by an undepicted drive motor so that the other two supporting rollers follow and rotate, whereby the intermediate transfer member **10** is rotated and moved. Simultaneously, photoreceptors **40**K, **40**Y, **40**C are rotated by the individual image forming units **18** so that single-color images in black, yellow, magenta, and cyan are formed on the photoreceptors **40**K, **40**Y, **40**C, **40**M, on which latent images have been formed due to the exposure by the exposure device **500**. While the intermediate transfer member **10** is moved, the single-color images are sequentially transferred so that a combined color image is formed on the intermediate transfer member **10**

Furthermore, when the undepicted start switch is pressed, one sheet feed roller **42** in the sheet feed table **200** is selected and rotated and the sheet is fed from one of multiple sheet feed cassettes **44** included in a paper bank **43**. The sheets are separated one by one by a separating roller **45**, and the sheet is conveyed to a sheet feed path **46**, conveyed by conveying rollers **47**, guided into a sheet feed path **48** in the copier main body **100**, and is stopped when the sheet hits a registration roller **49**. If the sheet is fed from a manual feed tray **51**, a sheet feed roller **50** is rotated so that the sheet on the manual feed tray **51** is fed, the sheets are separated one by one by a separating roller **52** so that the sheet is delivered to a manual sheet feed path **53** and is then stopped when the sheet hits the registration roller **49** in the same manner.

The registration roller **49** is rotated with the same timing as the combined color image on the intermediate transfer member **10**; the sheet is conveyed into the gap between the intermediate transfer member **10** and the secondary transfer device **22**; and then the image is transferred by the secondary transfer device **22** so that a color image is recorded on the sheet.

After the image has been transferred, the sheet is conveyed to the fixing device **60** by the secondary transfer device **22**. After the fixing device **60** applies heat and pressure to fix the transferred image, the sheet is discharged by a discharge roller **56** due to switching of a switching claw **55**, and is then stacked on a discharge tray **57**. Alternatively, the sheet is conveyed to the sheet reverse device **28** due to switching of the switching claw **55**, whereby the sheet is turned over and is guided to the transfer position again. After an image is recorded on the back side, the sheet is discharged to the discharge tray **57** by the discharge roller **56**.

Furthermore, after the image has been transferred, the intermediate-transfer-member cleaning device **17** removes residual toner that remains on the intermediate transfer member **10** so that the intermediate transfer member **10** stands by for the tandem image forming device **20** to form an image again.

Next, an explanation is given of the fixing device **60** according to the embodiment. FIG. **2** is a schematic diagram that illustrates the fixing device according to the embodiment. In the fixing device **60**, the fixing belt **61** that is a fixing member is extended between a fixing roller **64** that is a driving roller and a heating roller **65** that is a driven roller so that the fixing belt **61** rotates and moves.

The pressing roller **62** is opposed to the fixing roller **64** via the fixing belt **61**. An undepicted pressing mechanism presses the pressing roller **62** against the fixing roller **64** via the fixing belt **61** so that a nip section N is formed. A fixing heater **66** is provided as a heat source in the heating roller **65**. The heating roller **65** is heated by the fixing heater **66**, and the fixing belt **61** is heated by the heating roller **65**. The fixing roller **64** is driven and rotated by an undepicted drive mechanism so that the fixing belt **61** is rotated and then the pressing roller **62** is rotated together with the fixing belt **61**. It is possible to drive the pressing roller **62**.

An undepicted temperature detecting element detects the surface temperature of the fixing belt **61**, and an undepicted temperature control unit controls the fixing heater **66** in accordance with the output value of the temperature detecting element so that the surface temperature of the fixing belt **61** becomes a predetermined temperature.

When an unfixed sheet material P passes through the fixing nip section N that is formed by the fixing belt **61**, whose temperature is controlled to be a predetermined temperature, and the pressing roller **62**, a toner image T is melted and fixed, and then the sheet material P is delivered out of the device main body. Although the pressing roller **62** is used as a pressing member, a pressing belt, or the like, may be used.

According to the embodiment, a tension roller **63** is provided on the outer side of the fixing belt **61** to maintain the tension of the fixing belt **61**. The tension roller **63** may be provided at the inner side or the outer side of the fixing belt **61**. The fixing device may be not only a belt fixing device but also what is called a roller fixing device that includes a pair of

rollers, i.e., a fixing member that includes a heat source and a pressing member that is pressed by it.

A nozzle member **80** is provided near the outlet of the fixing nip section N in the fixing device **60**. The nozzle member **80** includes an air ejection port **85** and is arranged in a sheet separating device (see FIG. **3**). In the fixing device according to the embodiment, multiple nozzle members **80** are arranged such that the narrowest area of the clearance between the nozzle member **80** and the fixing belt **61** is equal to or less than 2.0 mm. Only the end of the nozzle member **80** is schematically illustrated in FIG. **2**. Furthermore, the nozzle member **80** may be arranged parallel to a non-contact separation claw (also referred to as a separation plate).

Compressed airflow A, which is controlled by an undepicted compressed-air supply source and an undepicted electromagnetic valve, passes through an end-section air passage **81***a* of the nozzle member **80** and is then sprayed toward the fixing nip section N from the air ejection port **85**. The end of the sheet material P is forcibly separated from the fixing belt **61** due to the compressed airflow.

Next, an explanation is given of a sheet separating device **70** where the nozzle member **80** is arranged. FIG. **3** is a perspective view of the sheet separating device according to the embodiment; FIG. **4** is a cross-sectional view of the nozzle member in the sheet separating device taken along the line B-B of FIG. **3**; FIG. **5** is a perspective view that illustrates the nozzle member in the sheet separating device; FIG. **6** is a cross-sectional view of the sheet separating device taken along the line C-C of FIG. **4**; and FIG. **7** is a perspective view that illustrates a shaft member in the sheet separating device.

Multiple nozzle members **80** are arranged along the longitudinal direction of the fixing roller **64**. Only one nozzle member **80** may be arranged in the middle along the cross direction of the fixing roller **64**.

As illustrated in FIG. **3**, the nozzle member **80** is supported by a shaft member **90**. The shaft member **90** is a tube-shaped member in which a gas passage **91** is formed to supply compressed air that is compressed gas. An opening **92** is formed on the shaft member **90** to supply compressed air to the nozzle member **80**. The opening **92** communicates with the gas passage **91**, and the number of openings **92** corresponds to the number of nozzle members **80** attached (see FIG. **7**).

The shaft member **90** is preferably made of a material that is resistant to decay, such as stainless steel (SUS) or an aluminum alloy. Because drain occurs due to the compressed air, decay due to the drain needs to be prevented. If SUM (sulfur and sulfur compound free-cutting steel) or the like is used, it is also necessary to perform plating on the inner wall of the tube passage to prevent decay. Furthermore, one side (the left side in the drawing) of the gas passage **91** of the shaft member **90** is sealed by a screw **93**. If the screw **93** is wrapped with a thin PTFE sheet or an adhesive material is applied to the screw **93**, the sealing performance is improved. According to the present embodiment, the screw **93** is fastened to seal the opening of the gas passage **91**; however, sealing may be performed by using a method such as welding or glueing if the opening of the gas passage **91** is sealed.

Compressed air is supplied through an opening **91***a* on the other end (on the right side in the drawing) of the shaft member **90** (the arrow in FIG. **3**). The shaft member **90** is supported by being inserted through side plates **72***a*, **72***b* of a movable stay **71**. The shaft member **90** is retained by a D-shaped opening in one or both side plates **72***a*, **72***b* so that the shaft member **90** is fixed and is not rotated with respect to the movable stay **72**. The outline shape of the shaft member **90** in the part that is attached to the movable stay **72** is also a D-shape in cross-section.

Positioning plates **78** are attached to the movable stay **72**, and the positioning plates **78** are pressed toward the fixing roller **64**. The end of the positioning plate **78** is in contact with the fixing roller **64** outside its maximum image fixed area. The positioning plate **78** oscillates in accordance with the thermal expansion or oscillation of the fixing roller **64** so that the interval between the end of the nozzle member **80** and the fixing roller **64** is kept at a constant value that is a set value equal to or less than 2 mm.

The movable stay **71** is swingably supported by a fixed stay **73**. Specifically, the shaft member **90** attached to the movable stay **71** is rotatably supported by side plates **74***a*, **74***b* of the fixed stay **73**. Therefore, the movable stay **71** can swing around the shaft member **90** together with the positioning plates **78** in relation to the fixed stay **73**.

The fixed stay **73** is fixed to the main body of the fixing device with a screw, or the like, through fixing sections **75***a*, **75***b*. Tension springs **76***a*, **76***b* are extended between the movable stay **71** and the fixed stay **73**, and the positioning plates **78** are pressed toward the fixing roller **64**. The ends of the tension spring **76***a* are attached to a projection **78***a* of the movable stay **71** and a projection **77***a* of the fixed stay **73**, and the ends of the tension spring **76***b* are attached to a projection **78***b* of the movable stay **71** and a projection **77***b* of the fixed stay **73**.

In the sheet separating device **70**, the air ejection port **85** formed at the end of the nozzle member **80** has, for example, □0.5×0.5 mm (a square, 0.5 mm on a side) or Ø0.5 mm (0.5 mm in diameter) for a smaller one or □2.0×2.0 mm or Ø2 mm for a larger one, preferably set in the range between about 0.19 square millimeters at a minimum and 4.0 square millimeters at a maximum.

If compressed air is ejected toward the fixing nip section N from the fixing and discharging direction, it is necessary to arrange the nozzle member **80**, which has a tube passage of compressed air, in the space for conveying sheets and in the space for the fixing roller **64**. An experimental study has shown that, if the effective cross-sectional area of the air ejection port **85** is equal to or less than 0.19 square millimeters, a sufficient amount of compressed air for separation cannot be ejected; and conversely, if it is equal to or greater than 4.0 square millimeters, the flow passage of air becomes too wide and the air cannot be ejected with an adequate flow passage for separation.

Next, a detailed explanation is given of the nozzle member **80**. In terms of heat resistance, the nozzle member **80** may be made of an engineering plastic, such as PPS (Polyphenylene sulfide), PEEK (polyether ether ketone), PET (polyethylene terephthalate), or PES (Polyethersulphone). Furthermore, if toner contamination of the end of the nozzle member **80** needs to be prevented, it is preferable to use PFA (tetrafluoroethylene/perfluoro alkyl vinyl ether copolymer) as the material or to apply PFA coating or PTFE (polytetrafluoroethylene (tetrafluoride)) coating to only an area that is to be contaminated. If the above coating is performed by burning, the material of the nozzle member **80** is preferably selected from materials, such as PEK (polyether ketone), PI (polyimide), or LCP (liquid crystalline polymer), which are resistant to burning.

The nozzle member **80** includes a tapered end section **81**, on the end of which the air ejection port **85** is formed; a rising section **82** that rises from the base portion of the end section **81**; a cylindrical attachment section **83** that is mounted on the rising section **82**; and a plate-like member **84** that extends from the attachment section **83** in the direction opposite to the end section **81**. An insert hole **83***a* is formed in the attachment section **83**, through which the shaft member **90** is rotatably inserted. Furthermore, an attachment-section air passage **82***a*

is formed in the rising section **82** and is communicated with the insert hole **83***a* of the attachment section **83**. An end-section air passage **81***a* is formed in the end section **81** so that it communicates with the attachment-section air passage **82***a* and leads to the air ejection port **85**.

The attachment-section air passage **82***a* and the end-section air passage **81***a* are collectively formed to be tapered. In the nozzle member **80** according to the embodiment, the effective cross-section of an opening **83***b* through which the attachment-section air passage **82***a* communicates with the insert hole **83***a* is Ø4 mm to Ø6 mm or has □4×4 mm to □6×6 mm.

Moreover, in the sheet separating device **70** according to the embodiment, an adjustment mechanism **95** is provided to adjust the positions of the fixing belt **61** and the air ejection port **85** of the nozzle member **80**.

As illustrated in FIG. **4**, the adjustment mechanism **95** includes a compression spring **96** that is a pressing member; a screw **97** (right-hand screw); and a stay **98** that supports the above components. The compression spring **96** is interposed between the stay **98** and the plate-like member **84** of the nozzle member **80** so that the position of the plate-like member **84** can be adjusted in relation to the stay **98**. In the adjustment mechanism **95**, when the screw **97** rotates in a clockwise direction about its axis, the nozzle member **80** rotates about its rotation axis, which is the shaft member **90**, in a clockwise direction in the drawing so that the end moves away from the fixing belt **61**. Conversely, if the screw **97** rotates in the counterclockwise direction, the nozzle member **80** rotates about its rotation axis, which is the shaft member **90**, in a counterclockwise direction in the drawing so that the clearance between the nozzle member **80** and the fixing roller **64** becomes smaller.

With the adjustment mechanism **95**, it is possible to adjust the positional relation between the air ejection port **85** of the nozzle member **80** and the fixing roller **64** or the fixing belt **61** so as to obtain the optimum value. The optimum value can be experimentally obtained.

As illustrated in FIG. **6**, the shaft member **90** is inserted into the nozzle member **80**, and the positions of the ends of the nozzle member **80** are set by E-rings **86** with respect to the shaft member **90**. O-rings **87** are provided between the shaft member **90** and the attachment section **83** of the nozzle member **80** and are attached to the areas on two sides of the shaft member **90** with the opening **92** interposed therebetween, whereby leakage of compressed air from the gap between the nozzle member **80** and the shaft member **90** is prevented. The O-ring **87** is provided in a groove **94** that is formed on the outer circumference of the shaft member **90**.

According to the present embodiment, when the fixing roller **64** rotates and oscillates, the positioning plates **78** that are pressed against the surface of the fixing roller **64** oscillate in accordance with the movement of the fixing roller **64**, and the movable stay **71** attached to the positioning plates **78** as well as the shaft member **90** make a back-and-forth oscillating movement in synchronization with the fixing roller **64**.

Due to the oscillating movement of the shaft member **90**, the nozzle member **80** oscillates; therefore, the distance between the fixing roller **64** and the nozzle member **80** is always kept constant so that compressed air is ejected to the fixing roller **64** in a stable manner and so that a problem can be prevented in that, because of a larger gap, the leading edge of a sheet of paper becomes stuck in the gap, which results in a paper jam.

As described above, in the image forming apparatus according to the present embodiment, the nozzle member is provided to spray compressed air at the gap between the fixed sheet material and the fixing member so as to separate the sheet, is rotatably supported by the shaft member, and is moved in accordance with the oscillation or thermal expansion of the fixing belt so that the clearance between the nozzle member and the fixing belt can be always constant, whereby it is possible to ensure separation of the sheet material from the fixing member.

According to the present embodiment, a nozzle member, which sprays compressed gas at the gap between the fixed sheet material and a fixing member so as to separate the sheet, is rotatably supported by a shaft member so that the positional relation between the nozzle member and the fixing member can be accurately maintained.

Although the invention has been described with respect to specific embodiments for a complete and clear disclosure, the appended claims are not to be thus limited but are to be construed as embodying all modifications and alternative constructions that may occur to one skilled in the art that fairly fall within the basic teaching herein set forth.

The invention claimed is:

1. A fixing device comprising:

a fixing member that is a rotary body having a heating unit;

a pressing member that is pressed against and is brought into contact with the fixing member; and

a sheet separating device with at least one nozzle member that discharges compressed gas from the direction of a nip outlet toward the nip section along the fixing member,

wherein the fixing device conveys the sheet material that carries unfixed toner thereon through a nip section formed by the fixing member and the pressing member so as to fix the unfixed toner image to the sheet material,

the sheet separating device separates the sheet material from the fixing member,

the nozzle member is rotatably supported by a shaft member that is provided parallel to the fixing member and includes a gas flow passage through which compressed gas is supplied to the nozzle member, and

the shaft member is rotatably supported by side plates.

2. The fixing device according to claim **1**, wherein

the nozzle member is provided such that a size of the narrowest area of clearance between the nozzle member and the fixing member is equal to or less than 2.0 mm.

3. The fixing device according to claim **1**, further comprising a positioning plate that is fixed to the shaft member and the nozzle member, wherein

the positioning plate is pressed against a surface of the fixing member and is rotated so that the distance between the nozzle member and the surface of the fixing member is kept constant.

4. The fixing device according to claim **3**, wherein the positioning plate is provided outside a maximum image fixed area of the fixing member.

5. The fixing device according to claim **1**, wherein

the nozzle member has a tapered shape and has a discharge port on its end, the discharge port having an effective cross-sectional area of 0.19 to 4.0 square millimeters, and

a compressed-gas flow passage that leads to the discharge port has a shape such that the compressed-gas flow passage is tapered continuously or intermittently from a point that has a larger effective cross-sectional area to the discharge port.

6. The fixing device according to claim **1**, wherein

the nozzle member is arranged such that the nozzle member is capable of rotating around the shaft member, and

the nozzle member is attached to the shaft member via an adjustment mechanism that adjusts the position of an end of the nozzle member in relation to the fixing member.

7. The fixing device according to claim **1**, wherein two or more ring-shaped sealing members are provided in a fitting clearance between the nozzle member and the tube-shaped shaft member.

8. An image forming apparatus comprising:

the fixing device according to claim **1**; and

an image forming unit that forms an unfixed toner image on a sheet that is conveyed to the fixing device.

9. The fixing device according to claim **1**, further comprising a fixed stay that is fixed to the fixing device, the fixed stay includes the side plates that rotatably support the shaft member.

10. The fixing device according to claim **9**, further comprising a movable stay is swingably supported by the fixed stay by tension springs that are extended between the movable stay and the fixed stay.

11. The fixing device according to claim **10**, further comprising a positioning plate that is attached to the movable stay, wherein

the positioning plate is pressed against a surface of the fixing member and is rotated so that the distance between the nozzle member and the surface of the fixing member is kept constant.

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